James Werner is part of a team bringing space fission power to a state of readiness for space exploration for manned or unmanned bases on the moon, Mars and other planets.

INL helps to develop power sources for future space missions

By Cathy Koon for *INL Communications & Governmental Affairs*

Idaho National Laboratory has been working since the summer of 2006 with the National Aeronautics and Space Administration (NASA) and the U.S. Department of Energy (DOE) to bring the technology for a Fission Surface Power System to a state of readiness for space exploration missions or outposts on the moon or Mars.

James Werner, staff nuclear engineer at INL, holds a model of the circular drum.

The project was the focus Sunday of an address to the 242nd National Meeting of the American Chemical Society (ACS) in Denver presented by James Werner, INL staff nuclear engineer in the Space Nuclear Systems and Technology Division.

Werner told the gathering the first nuclear power plant being considered for production of electricity for manned or unmanned bases on the moon, Mars and other planets may look like it came from outer space rather than Earth. Innovative technology for nuclear surface power applications is far different from the familiar terrestrial nuclear power stations, which sprawl over huge tracts of land and have large structures like cooling towers.

Bringing space fission power to a state of readiness for exploration means being able to demonstrate the various components and systems and show they have cleared the hurdle of technology readiness. NASA and DOE, with their industry partners, are poised to push through to this objective.

A plastic half-size model of the Fission Surface Power System

Hardware for a 12 kWe non-nuclear Fission Power System Technology Demonstration Unit is being fabricated now on a schedule that will enable a low-cost demonstration of technology readiness in the mid-2010s, with testing beginning as early as 2012. With space fission power system technology demonstrated, exploration mission planners will have the flexibility to respond to a broad variety of missions. They will be able to provide abundant power so that future explorers will, in planning or crisis, have the power they need when they most need it.

"Fission power technology can be applied on Earth's moon, on Mars, or wherever NASA sees the need for continuous power," Werner told the ACS gathering.

Sunlight and fuel cells have been the mainstays for generating electricity for space missions in the past, but engineers have realized that solar energy has limitations. Nuclear power offers some unique capabilities that could support manned outposts on other planets or moons. Solar cells work great in supplying electricity in near-Earth orbits and for satellite-borne equipment.

"The biggest difference between solar and nuclear reactors is its availability to produce power in any environment," Werner explained.

"Fission power technology doesn't rely on sunlight, making it able to produce large, steady amounts of power in harsh environments or at night like those found on the moon or Mars. A fission power system on the moon could generate 40 kilowatts or more of electric power, approximately the same amount of energy needed to power eight houses on Earth."

In addition, he said that a fission power system could operate in a variety of locations such as in craters, canyons or caves.

Werner says in the past five years INL has made many contributions to this project, including participating in the development of a program cost estimate for the entire system, preparing a pre-conceptual design, assessing nuclear fuels and associated fabrication issues, and participating in the design and construction of two annular linear induction pumps (ALIP).

A non-nuclear technology demonstration unit to be operated in a space environment inside a large vacuum chamber at NASA's Glenn Research Center is scheduled to be built next year. Testing will begin in 2013. Werner leads INL's involvement in this cooperative project between NASA and DOE. Other participating national labs include Oak Ridge National Laboratory, Sandia National Laboratory and Los Alamos National Laboratory.

Research for the Fission Surface Power System has been conducted at the Space and Security Power Systems Facility at INL.

NASA completed a fact sheet on the research.

"We helped in the design, and we built the ALIP pump to be used in the demonstration unit," Werner says. Other groups also designed and built parts for the demonstration unit.

Werner serves as program manager for INL's efforts in support of developing and testing space nuclear reactor technology for NASA and DOE. His current research interests include development and testing of high-temperature fuels and materials, evaluation and design of high-temperature liquid metal pumps and design and construction of test capabilities to support testing of reactor components and systems for the Fission Surface Power project and Nuclear Thermal Propulsion. Werner also serves as the INL relationship manager for coordinating work with NASA.

Werner contends that once the technology is developed and validated, it may prove to be one of the most affordable and versatile options for providing long-term base power for the space exploration programs.

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